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# VM8016

## LOW THERMAL MUX MODULE

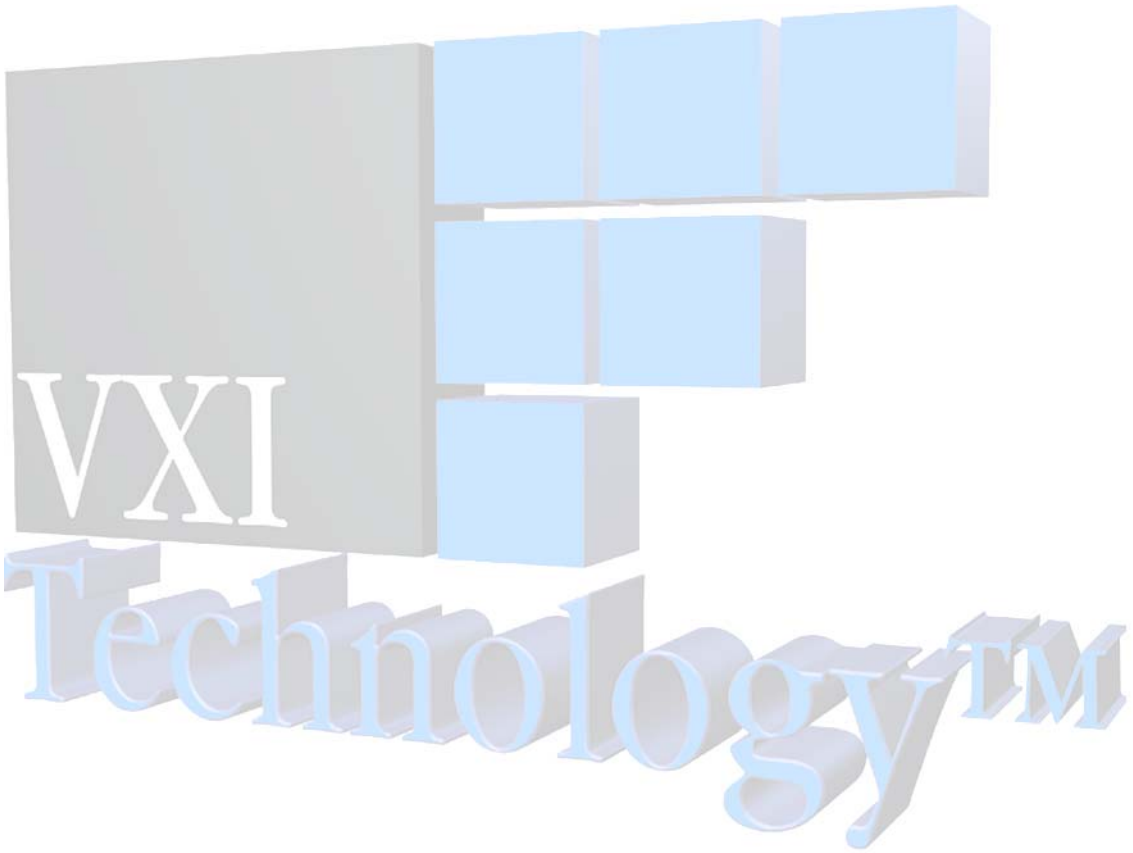
## USER'S MANUAL

**P/N: 82-0037-000**
**Rev. September 23, 2008**

**VXI Technology, Inc.**

**2031 Main Street**
**Irvine, CA 92614-6509**
**(949) 955-1894**

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# TABLE OF CONTENTS

**INTRODUCTION**

TABLE OF CONTENTS ..... 3
Certification ..... 6
Warranty ..... 6
Limitation of Warranty ..... 6
Restricted Rights Legend ..... 6
DECLARATION OF CONFORMITY ..... 7
GENERAL SAFETY INSTRUCTIONS ..... 9
Terms and Symbols ..... 9
Warnings ..... 9
SUPPORT RESOURCES ..... 11

**SECTION 1 ..... 13**

INTRODUCTION ..... 13
Introduction ..... 13
General Description ..... 14
VM8016 Specifications ..... 16

**SECTION 2 ..... 17**

PREPARATION FOR USE ..... 17
Installation ..... 17
Calculating System Power and Cooling Requirements ..... 17
Setting the Chassis Backplane Jumpers ..... 17
Setting the Logical Address ..... 18
Front Panel Interface Wiring ..... 18

**SECTION 3 ..... 21**

PROGRAMMING ..... 21
Introduction ..... 21
Notation ..... 23
REGISTER ACCESS ..... 24

**SECTION 4 ..... 27**

COMMAND DICTIONARY ..... 27
Introduction ..... 27
Alphabetical Command Listing ..... 27
Command Dictionary ..... 31
IEEE 488.2 COMMON COMMANDS ..... 32
*CLS ..... 32
*ESE ..... 33
*ESR? ..... 34
*IDN? ..... 35
*OPC ..... 36
*RST ..... 37
*SRE ..... 38
*STB? ..... 39
*TRG ..... 40
*TST? ..... 41
*WAI ..... 42
INSTRUMENT SPECIFIC SCPI COMMANDS ..... 43
ROUTe:CLOSe ..... 44
ROUTe:DELay ..... 45
ROUTe:OPEN ..... 46
ROUTe:SPECial ..... 47
ROUTe:TYPE ..... 48



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REQUIRED SCPI COMMANDS....49
STATus:OPERation:CONDition?....49
STATus:OPERation:ENABle....50
STATus:OPERation:EVENt?....51
STATus:PRESet....52
STATus:QUEStionable:CONDition?....53
STATus:QUEStionable:ENABle....54
STATus:QUEStionable:EVENt....55
SYSTem:ERRor?....56
SYSTem:VERSion?....57
**INDEX....59**



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## CERTIFICATION

VXI Technology, Inc. (VTI) certifies that this product met its published specifications at the time of shipment from the factory. VTI further certifies that its calibration measurements are traceable to the United States National Institute of Standards and Technology (formerly National Bureau of Standards), to the extent allowed by that organization's calibration facility, and to the calibration facilities of other International Standards Organization members.

## WARRANTY

The product referred to herein is warranted against defects in material and workmanship for a period of three years from the receipt date of the product at customer's facility. The sole and exclusive remedy for breach of any warranty concerning these goods shall be repair or replacement of defective parts, or a refund of the purchase price, to be determined at the option of VTI.

For warranty service or repair, this product must be returned to a VXI Technology authorized service center. The product shall be shipped prepaid to VTI and VTI shall prepay all returns of the product to the buyer. However, the buyer shall pay all shipping charges, duties, and taxes for products returned to VTI from another country.

VTI warrants that its software and firmware designated by VTI for use with a product will execute its programming when properly installed on that product. VTI does not however warrant that the operation of the product, or software, or firmware will be uninterrupted or error free.

## LIMITATION OF WARRANTY

The warranty shall not apply to defects resulting from improper or inadequate maintenance by the buyer, buyer-supplied products or interfacing, unauthorized modification or misuse, operation outside the environmental specifications for the product, or improper site preparation or maintenance.

VXI Technology, Inc. shall not be liable for injury to property other than the goods themselves. Other than the limited warranty stated above, VXI Technology, Inc. makes no other warranties, express or implied, with respect to the quality of product beyond the description of the goods on the face of the contract. VTI specifically disclaims the implied warranties of merchantability and fitness for a particular purpose.

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# DECLARATION OF CONFORMITY

**Declaration of Conformity According to ISO/IEC Guide 22 and EN 45014**

| | |
|---|---|
| **MANUFACTURER'S NAME** | VXI Technology, Inc. |
| **MANUFACTURER'S ADDRESS** | 2031 Main Street<br>Irvine, California 92614-6509 |
| **PRODUCT NAME** | Low Thermal Mux Module |
| **MODEL NUMBER(S)** | VM8016 |
| **PRODUCT OPTIONS** | All |
| **PRODUCT CONFIGURATIONS** | All |

*VXI Technology, Inc. declares that the aforementioned product conforms to the requirements of the* Low Voltage Directive 73/23/EEC *and the* EMC Directive 89/366/EEC *(inclusive* 93/68/EEC*) and carries the "CE" mark accordingly. The product has been designed and manufactured according to the following specifications:*

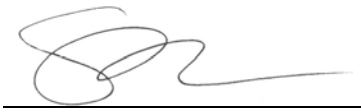
| | |
|---|---|
| **SAFETY** | EN61010 (2001) |
| **EMC** | EN61326 (1997 w/A1:98) Class A<br>CISPR 22 (1997) Class A<br>VCCI (April 2000) Class A<br>ICES-003 Class A (ANSI C63.4 1992)<br>AS/NZS 3548 (w/A1 & A2:97) Class A<br>FCC Part 15 Subpart B Class A<br>EN 61010-1:2001 |

The product was installed into a C-size VXI mainframe chassis and tested in a typical configuration.

*I hereby declare that the aforementioned product has been designed to be in compliance with the relevant sections of the specifications listed above as well as complying with all essential requirements of the Low Voltage Directive.*

**August 2006**

CE



***Steve Mauga, QA Manager***



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# GENERAL SAFETY INSTRUCTIONS

Review the following safety precautions to avoid bodily injury and/or damage to the product. These precautions must be observed during all phases of operation or service of this product. Failure to comply with these precautions, or with specific warnings elsewhere in this manual, violates safety standards of design, manufacture, and intended use of the product.

***Service should only be performed by qualified personnel.***

## TERMS AND SYMBOLS

These terms may appear in this manual:

**WARNING** Indicates that a procedure or condition may cause bodily injury or death.

**CAUTION** Indicates that a procedure or condition could possibly cause damage to equipment or loss of data.

These symbols may appear on the product:



**ATTENTION -** Important safety instructions



Frame or chassis ground



Indicates that the product was manufactured after August 13, 2005. This mark is placed in accordance with *EN 50419, Marking of electrical and electronic equipment in accordance with Article 11(2) of Directive 2002/96/EC (WEEE).* End-of-life product can be returned to VTI by obtaining an RMA number. Fees for take-back and recycling will apply if not prohibited by national law.

## WARNINGS

Follow these precautions to avoid injury or damage to the product:

**Use Proper Power Cord** To avoid hazard, only use the power cord specified for this product.

**Use Proper Power Source** To avoid electrical overload, electric shock, or fire hazard, do not use a power source that applies other than the specified voltage.

**Use Proper Fuse** To avoid fire hazard, only use the type and rating fuse specified for this product.



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## WARNINGS (CONT.)

**Avoid Electric Shock**

To avoid electric shock or fire hazard, do not operate this product with the covers removed. Do not connect or disconnect any cable, probes, test leads, etc. while they are connected to a voltage source. Remove all power and unplug unit before performing any service. ***Service should only be performed by qualified personnel.***

**Ground the Product**

This product is grounded through the grounding conductor of the power cord. To avoid electric shock, the grounding conductor must be connected to earth ground.

**Operating Conditions**

To avoid injury, electric shock or fire hazard:

- Do not operate in wet or damp conditions.
- Do not operate in an explosive atmosphere.
- Operate or store only in specified temperature range.
- Provide proper clearance for product ventilation to prevent overheating.
- DO NOT operate if any damage to this product is suspected. ***Product should be inspected or serviced only by qualified personnel.***



**Improper Use**

The operator of this instrument is advised that if the equipment is used in a manner not specified in this manual, the protection provided by the equipment may be impaired.
Conformity is checked by inspection.



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# SUPPORT RESOURCES

Support resources for this product are available on the Internet and at VXI Technology customer support centers.

**VXI Technology**
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2031 Main Street
Irvine, CA 92614-6509

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Fax: (949) 955-3041

**VXI Technology**
**Cleveland Instrument Division**

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Fax: (216) 447-8951

**VXI Technology**
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# SECTION 1

# INTRODUCTION

## INTRODUCTION

The VM8016 VXI module is a high precision, low thermal relay multiplexer designed for use in high accuracy applications.

The instrument uses the message-based word-serial interface for programming and data movement, as well as supporting direct register access for very high-speed data throughput. The VM8016 command set conforms to the SCPI standard for consistency and ease of programming.

The VM8016 is a member of the VXI Technology, Inc. VMIP™ (*VXI Modular Instrumentation Platform*) family and is available as a 16-, 32-, or 48-channel, single-wide C-size VXIbus module. In addition to these three standard configurations, the VM8016 may be combined with any of the other members of the VMIP™ family to form a customized and highly integrated instrument (see Figure 1-1). This allows the user to reduce system size and cost by combining the VM8016 with two other instrument functions in a single-wide C-size VXIbus module.

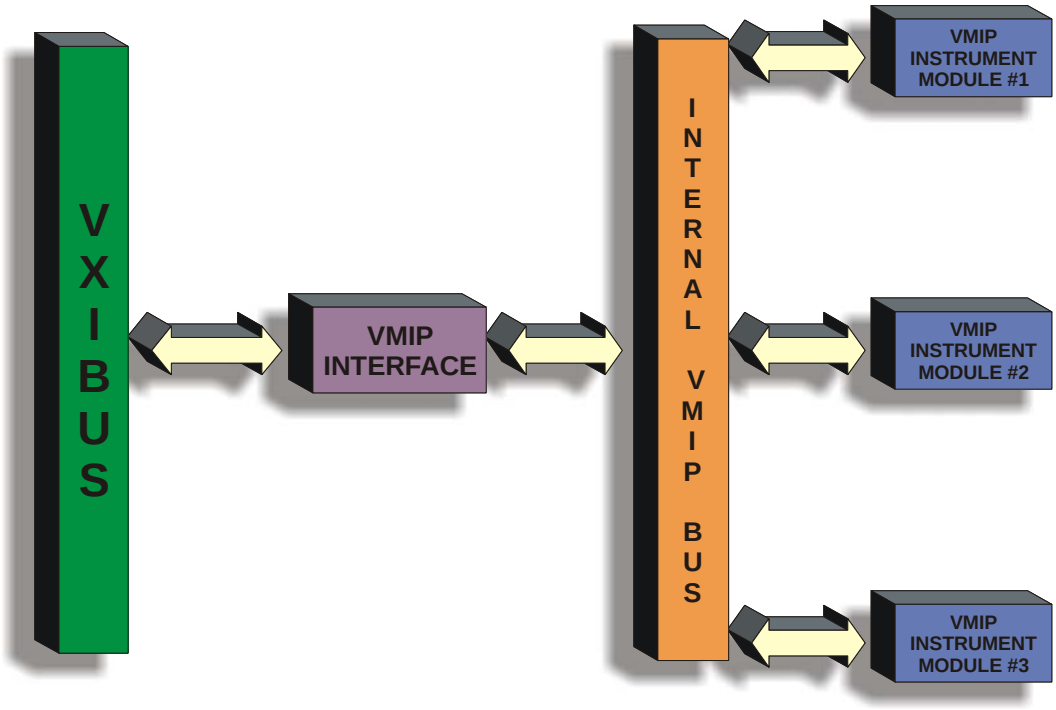
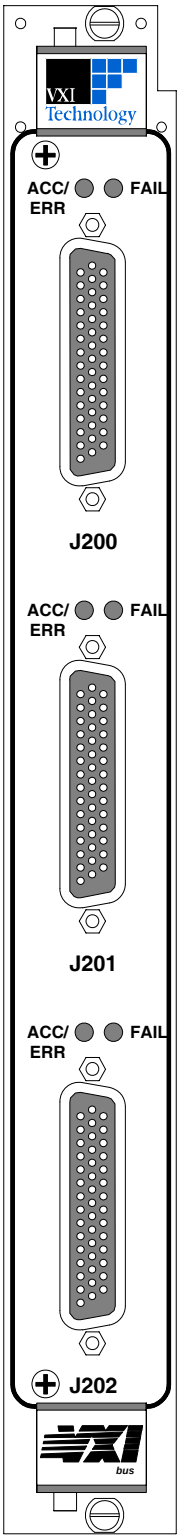



**FIGURE 1-1: VMIP™ PLATFORM**



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## GENERAL DESCRIPTION

The VM8016 has two banks of eight channels each and can be configured for either 16-channel/2-wire or 8-channel/4-wire use. As part of the VMIP family of instruments, it can be combined with up to two other modules to form a high-density VXIbus instrument that fully utilizes the capabilities of the VMIP. This gives the capability of up to 48-channel/2-wire or 24-channel/4-wire configurations.

When the module is configure as 16-channel/2-wire, the two banks function independently and one channel from each bank can be selected at the same time. When the module is configured as an 8-channel/4-wire, the two banks function together in parallel. For example, Channel 1 and Channel 9 would be paired to make up one 4-wire output, Channels 2 and 10 would be paired, and so on. See Figure 1-2.

When the module is in normal mode, only one channel from each bank (or one set of 4-wire channels) can be selected at a time. To select multiple channels, the module must be in Special mode. See the [ROUTe:]SPECial command in the Command Dictionary section for more information on Normal or Special mode.

The VM8016 is programmed using word-serial message-based commands that are SCPI compatible. SCPI commands are available to configure the VM8016 as either a 2- or 4-wire multiplexer. Commands can also be used to program delays between relay closures to synchronize with external devices such as DMMs, or to simply to open or close relays. See the Command Dictionary section for command functions.

**FIGURE 1-2: FRONT PANEL LAYOUT**



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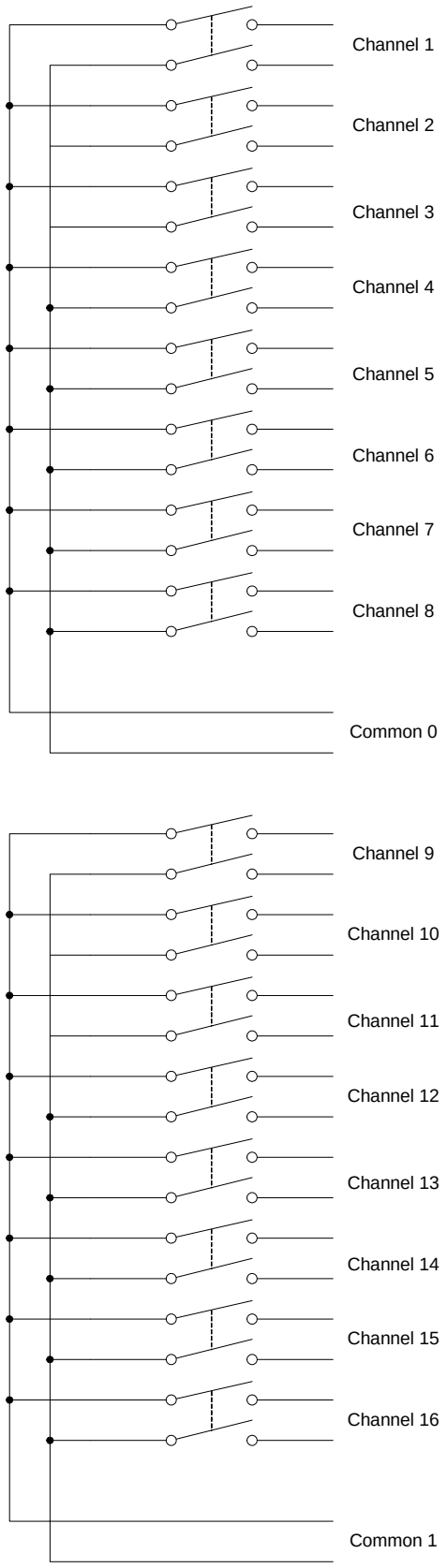



**FIGURE 1-3: VM8016 16 CHANNEL LAYOUT**



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## VM8016 SPECIFICATIONS

| GENERAL SPECIFICATIONS |
|---|
| **MAXIMUM SWITCHING VOLTAGE** |
| 200 VDC or 200 V peak ac |
| **MAXIMUM SWITCHING CURRENT** |
| 0.5 A |
| **MAXIMUM CARRY CURRENT** |
| 1.0 A |
| **MAXIMUM POWER PER CHANNEL** |
| 10 W |
| **MAXIMUM THERMAL EMF** |
| < 1 µV |
| **CLOSED CHANNEL PATH RESISTANCE** |
| < 0.75 Ω |
| **INSULATION RESISTANCE** |
| $10^{11}$ Ω (between two points) |
| **CLOSED CHANNEL CAPACITANCE** |
| 50 pF |
| **MAXIMUM BANDWIDTH** |
| 50 MHz |
| **MAXIMUM RELAY LIFE** |
| 100 x $10^6$ operations (1 V, 10 mA) |



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# SECTION 2

# PREPARATION FOR USE

## INSTALLATION

When the VM8016 is unpacked from its shipping carton, the contents should include the following items:

(1) VM8016 VXIbus module
(1) VM8016 Module User's Manual (this manual)

All components should be immediately inspected for damage upon receipt of the unit.

Once the VM8016 is assessed to be in good condition, it may be installed into an appropriate C-size or D-size VXIbus chassis in any slot other than slot 0. The chassis should be checked to ensure that it is capable of providing adequate power and cooling for the VM8016. Once the chassis is found to be adequate, the VM8016's logical address and the chassis' backplane jumpers should be configured prior to the VM8016's installation.

## CALCULATING SYSTEM POWER AND COOLING REQUIREMENTS

It is imperative that the chassis provide adequate power and cooling for this module. Referring to the chassis user's manual, confirm that the power budget for the system (the chassis and all modules installed therein) is not exceeded and that the cooling system can provide adequate airflow at the specified backpressure.



It should be noted that if the chassis cannot provide adequate power to the module, the instrument may not perform to specification or possibly not operate at all. In addition, if adequate cooling is not provided, the reliability of the instrument will be jeopardized and permanent damage may occur. Damage found to have occurred due to inadequate cooling would also void the warranty of the module.

## SETTING THE CHASSIS BACKPLANE JUMPERS

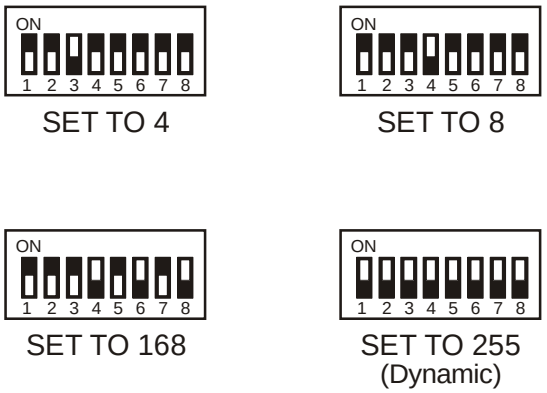
Please refer to the chassis user's manual for further details on setting the backplane jumpers.



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## SETTING THE LOGICAL ADDRESS

The logical address of the VM8016 is set by a single 8-position DIP-switch located near the module's backplane connectors (this is the only switch on the module). The switch is labeled with positions 1 through 8 and with an ON position. Switches pushed toward the ON legend signify a logic 1; switches pushed away from the ON legend signify a logic 0. The switch located at position 1 is the least significant bit while the switch located at position 8 is the most significant bit. See Figure 2-1 for examples of setting the logical address switch.




| Switch Position | Switch Value |
|---|---|
| 1 | 1 |
| 2 | 2 |
| 3 | 4 |
| 4 | 8 |
| 5 | 16 |
| 6 | 32 |
| 7 | 64 |
| 8 | 128 |

**FIGURE 2-1: LOGICAL ADDRESS SWITCH SETTING EXAMPLES**

The VMIP may contain three separate instruments and will allocate logical addresses as required by the VXIbus specification (revisions 1.3 and 1.4). The logical address of the instrument is set on the VMIP carrier. The VMIP logical addresses must be set to an even multiple of 4 *unless dynamic addressing is used*. Switch positions 1 and 2 must always be set to the OFF position. Therefore, only addresses of 4, 8, 12, 16, ... 252 are allowed. The address switch should be set for one of these legal addresses and the address for the second instrument (the instrument in the center position) will automatically be set to the switch set address plus one; while the third instrument (the instrument in the lowest position) will automatically be set to the switch set address plus two. If dynamic address configuration is desired, the address switch should be set for a value of 255 (All switches set to ON). Upon power-up, the slot 0 resource manager will assign the first available logical addresses to each instrument in the VMIP module.

If dynamic address configuration is desired, the address switch should be set for a value of 255. (All switches set to ON). Upon power-up, the slot 0 resource manager will assign the first available logical addresses to each instrument in the VMIP module.

## FRONT PANEL INTERFACE WIRING

The 16-channel version (VM8016-1) has a connector labeled J201 that contains all signals for this instrument. The 32-channel version (VM8016-2) has J201 and J202 provided, while the 48-channel version (VM8016-3) has J200, J201, and J202. The wiring for each of these connectors is identical and since each group of 16 channels is treated as a separate instrument, a VM8016-3 has three Channel 1s, three Channel 2s, three Channel 3s, etc.

Regardless of whether the VM8016 is configured with other VM8016 modules or with other VMIP modules, each module is treated as an independent instrument in the VXIbus chassis. As such, each group has its own FAIL and ACCESS light.



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**TABLE 2-1: VM8016 PIN ASSIGNMENTS**

| PIN | SIGNAL | PIN | SIGNAL | PIN | SIGNAL | PIN | SIGNAL |
|---|---|---|---|---|---|---|---|
| 1 | +CHANNEL 1 | 12 | +CHANNEL 12 | 23 | -CHANNEL 8 | 34 | -CHANNEL 14 |
| 2 | +CHANNEL 2 | 13 | SHIELD | 24 | -CHANNEL 9 | 35 | +CHANNEL 15 |
| 3 | +CHANNEL 3 | 14 | +COMMON 0 | 25 | -CHANNEL 10 | 36 | -CHANNEL 15 |
| 4 | +CHANNEL 4 | 15 | +COMMON 1 | 26 | -CHANNEL 11 | 37 | +CHANNEL 16 |
| 5 | +CHANNEL 5 | 16 | -CHANNEL 1 | 27 | -CHANNEL 12 | 38 | -CHANNEL 16 |
| 6 | +CHANNEL 6 | 17 | -CHANNEL 2 | 28 | SHIELD | 39 | SHIELD |
| 7 | +CHANNEL 7 | 18 | -CHANNEL 3 | 29 | -COMMON 0 | 40 | SHIELD |
| 8 | +CHANNEL 8 | 19 | -CHANNEL 4 | 30 | -COMMON 1 | 41 | FP OPEN |
| 9 | +CHANNEL 9 | 20 | -CHANNEL 5 | 31 | +CHANNEL 13 | 42 | GND |
| 10 | +CHANNEL 10 | 21 | -CHANNEL 6 | 32 | -CHANNEL 13 | 43 | GND |
| 11 | +CHANNEL 11 | 22 | -CHANNEL 7 | 33 | +CHANNEL 14 | 44 | FP TRIG |

The connector for the VM8016 board is a 44-pin female high-density DSUB type. A solder cup type mating connector is provided with each unit. Typical part numbers for the mating connectors include:

| | | |
|---|---|---|
| AMP P/N: | 748366-1 | SHELL |
| AMP P/N: | 748333-4 | CONTACT |
| AMP P/N: | 90430-1 | HAND CRIMP TOOL |

The pin locations for J200, J201 and J202 are shown in Figure 2-2.

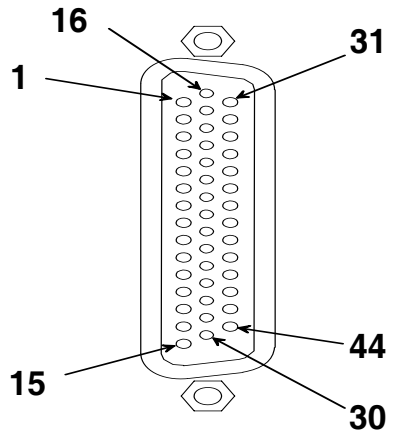



**FIGURE 2-2: J200, J201, AND J202 PIN LOCATIONS**



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# SECTION 3

# PROGRAMMING

## INTRODUCTION

The VM8016 is a VXIbus message-based device whose command set is compliant with the Standard Command for Programmable Instruments (SCPI) programming language.

All module commands are sent over the VXIbus backplane to the module. Commands may be in upper, lower, or mixed case. All numbers are sent in ASCII decimal unless otherwise noted.

The module recognizes SCPI commands. SCPI is a tree-structured language based on IEEE-STD-488.2 Specifications. It utilizes the IEEE-STD-488.2 Standard command, and the device dependent commands are structured to allow multiple branches off the same trunk to be used without repeating the trunk. To use this facility, terminate each branch with a semicolon. As an example, **POLarity**, **STATe**, and **TTLTrg** are all branches off the **RESet:OUTPut** trunk and can be combined as follows:

```
RESet:OUTPut:POLarity POS;STATe 1;TTLTrg 4
```

The above command has the same effect as the following three:

```
RESet:OUTPut:POLarity POS
RESet:OUTPut:STATe 1
RESet:OUTPut:TTLTrg 4
```

*See the Standard Command for Programmable Instruments (SCPI)* Manual, Volume 1: Syntax & Style, Section 6, for more information.



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The SCPI commands in this section are listed in upper and lower case. Character case is used to indicate different forms of the same command. Keywords can have both a short form and a long form (some commands only have one form). The short form uses just the keyword characters in uppercase. The long form uses the keyword characters in uppercase plus the keyword characters in lowercase. Either form is acceptable. Note that there are no intermediate forms. All characters of the short form or all characters of the long form must be used. Short forms and long forms may be freely intermixed. The actual commands sent can be in upper case, lower case or mixed case (case is only used to distinguish short and long form for the user). As an example, these commands are all correct and all have the same effect:

```
RESet:OUTPut:STATe 1
reset:output:state 1
RESET:OUTPUT:STATE 1
RES:OUTPut:STATe 1
RES:OUTP:STATe 1
RES:OUTP:STAT 1
res:outp:stat 1
```

The following command is **not** correct because it doesn't use the complete short form of **OUTPut**:

| | |
|---|---|
| `RES:OUT:STAT 1` | (incorrect syntax - missing "p" - only **outp** or **output** is correct) |

All of the SCPI commands also have a query form unless otherwise noted. Query forms contain a question mark (?). The query form allows the system to ask what the current setting of a parameter is. The query form of the command generally replaces the parameter with a question mark (?). Query responses do not include the command header. This means only the parameter is returned: no part of the command or "question" is returned.

When character data is used for a parameter, both short and long forms are recognized. If the command has a query form with character response data, the short form is always returned in upper case. As an example, to find out what the current trigger source setting is use the following command:

```
RES:OUTP:POL?
```

The response would be:

```
POS
```

This tells the user that the Reset Output signal polarity has been set to a positive edge.



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## NOTATION

Keywords or parameters enclosed in square brackets ([ ]) are optional. If the optional part is a keyword, the keyword can be included or left out. Omitting an optional parameter will cause its default to be used.

Parameters are enclosed by angle brackets (< >). Braces ({ }), or curly brackets, are used to enclose one or more parameters that may be included zero or more times. A vertical bar (|), read as "or", is used to separate parameter alternatives.



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# REGISTER ACCESS

The VM8016 provides direct register access for faster data access. The register map is shown in Table 3-1.

**TABLE 3-1: VM8016 A16 MEMORY**

| Offset | Description |
|---|---|
| 3E | |
| 3C | |
| 3A | |
| 38 | |
| 36 | |
| 34 | |
| 32 | |
| 30 | |
| 2E | |
| 2C | |
| 2A | |
| 28 | |
| 26 | |
| 24 | |
| 22 | |
| 20 | Relay Address 1 - 16 |
| 1E | |
| 1C | |
| 1A | |
| 18 | |
| 16 | [ A32 Pointer Low ] |
| 14 | [ A32 Pointer High ] |
| 12 | [ A24 Pointer Low ] |
| 10 | [ A24 Pointer High ] |
| E | Data Low |
| C | Data High |
| A | Response [/Data Extended] |
| 8 | Protocol [/Signal] Register |
| 6 | [Offset Register] |
| 4 | Status / Control Register |
| 2 | Device Type |
| 0 | ID Register |



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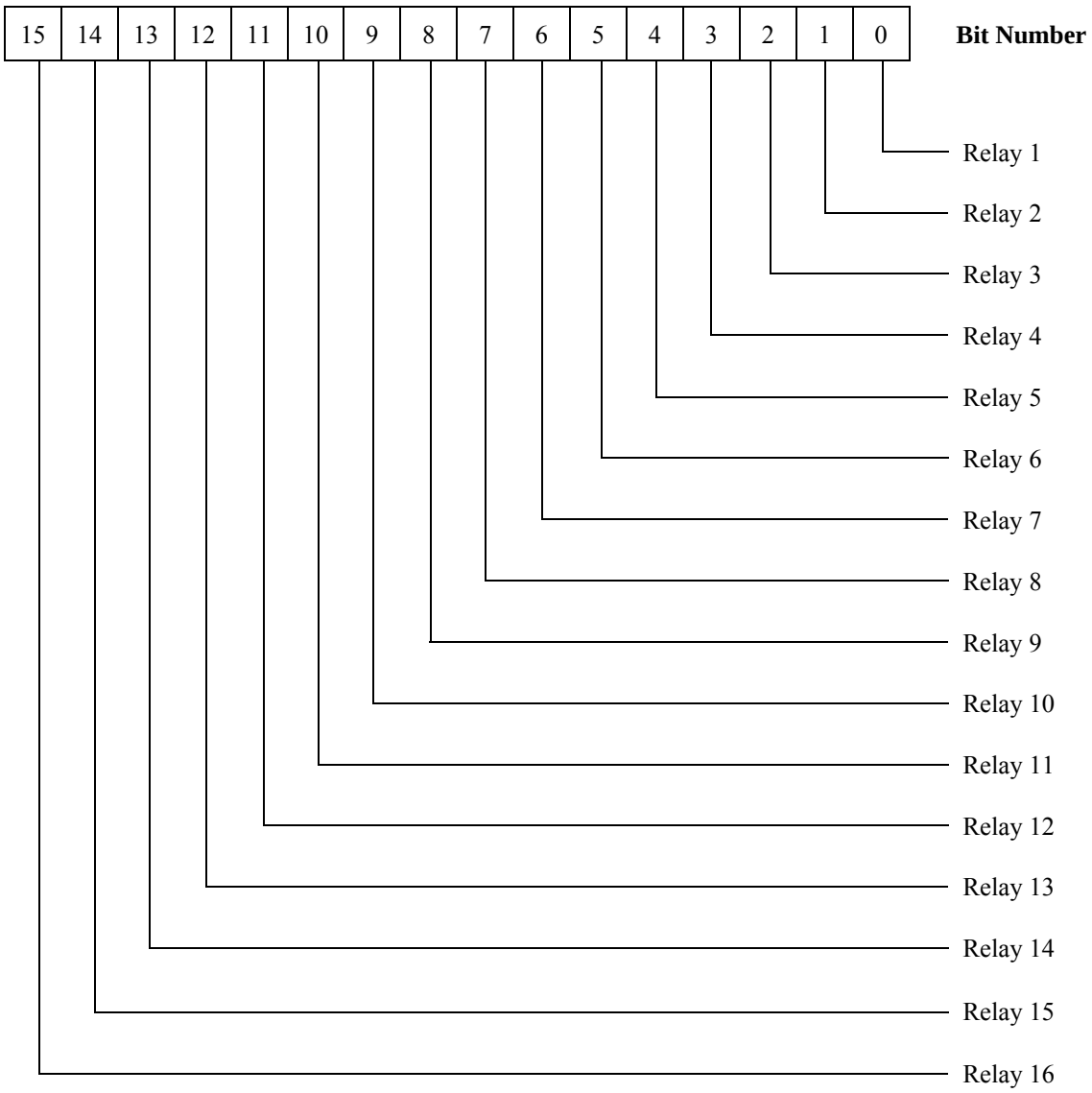



**FIGURE 3-1: RELAY REGISTER**



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# SECTION 4

# COMMAND DICTIONARY

## INTRODUCTION

This section presents the instrument command set. It begins with an alphabetical list of all the commands supported by the VM8016 divided into three sections: IEEE 488.2 commands, the instrument specific SCPI commands and the required SCPI commands. With each command is a brief description of its function, whether the command's value is affected by the *RST command and its default value.

The remainder of this section is devoted to describing each command, one per page, in detail. The description is presented in a regular and orthogonal way assisting the user in the use of each command. Every command entry describes the exact command and query syntax, the use and range of parameters and a complete description of the command's purpose.

## ALPHABETICAL COMMAND LISTING

The following tables provide an alphabetical listing of each command supported by the VM8016 along with a brief description. If an X is found in the column titled *RST, then the value or setting controlled by this command is possibly changed by the execution of the *RST command. If no X is found, then *RST has no effect. The default column gives the value of each command's setting when the unit is powered up or when a *RST command is executed.



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**TABLE 4-1: IEEE 488.2 COMMON COMMANDS**

| Command | Description | *RST | Reset Value |
|---|---|---|---|
| *CLS | Clear the Status Register. | X | |
| *ESE | Set the Event Status Enable Register. | | N/A |
| *ESR? | Query the Standard Event Status Register | | N/A |
| *IDN? | Query the module identification string. | | N/A |
| *OPC | Set the OPC bit in the Event Status Register | X | 0 |
| *RST | Reset the module to a known state | | N/A |
| *SRE | Set the service request enable register | | N/A |
| *STB? | Query the Status Byte Register. | | N/A |
| *TRG | Causes a trigger event to occur. | | N/A |
| *TST? | Starts and reports a self-test procedure. | | N/A |
| *WAI | Halts execution and queries | | N/A |



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**TABLE 4-2: INSTRUMENT SPECIFIC SCPI COMMANDS**

| Command | Description | *RST | Reset Value |
|---|---|---|---|
| ROUTe:CLOSe | Connect a channel to its output pins | X | All channels Open |
| ROUTe:DELay | Sets the relay settling time | X | 0.002 sec |
| ROUTe:OPEN | Disconnect a channel from its output pins | X | All channels Open |
| ROUTe:SPECial | Allows for single or multiple channel operation | X | Single |
| ROUTe:TYPE | Select 2-wire or 4-wire operation | X | 2-wire |



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**TABLE 4-3: REQUIRED SCPI COMMANDS**

| Command | Description | *RST | Reset Value |
|---|---|---|---|
| STATus:OPERation:CONDition? | Query the Operation Status Condition Register. | X | |
| STATus:OPERation:ENABle | Sets the Operation Status Enable Register. | X | |
| STATus:OPERation[:EVENt]? | Query the Operation Status Event Register. | X | |
| STATus:PRESet | Presets the Status Register. | X | |
| STATus:QUEStionable:CONDition? | Query the Questionable Status Condition Register. | X | |
| STATus:QUEStionable:ENABle | Sets the Questionable Status Enable Register. | X | |
| STATus:QUEStionable[:EVENt]? | Query the Questionable Status Event Register | X | |
| SYSTem:ERRor? | Query the Error Queue. | X | Clears queue |
| SYSTem:VERsion? | Query which version of the SCPI standard the module complies with. | | N/A |



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## COMMAND DICTIONARY

The remainder of this section is devoted to the actual command dictionary. Each command is fully described on its own page. In defining how each command is used, the following items are described:

| | |
|---|---|
| **Purpose** | Describes the purpose of the command. |
| **Type** | Describes the type of event, such as type or setting. |
| **Command Syntax** | Details the exact command format |
| **Command Parameters** | Describes the parameters sent with the command and their legal parameters |
| ***RST Value** | Describes the value assumed when the *RST (reset) command is sent. |
| **Query Syntax** | Details the exact query form of the command. |
| **Query Parameters** | Describes the parameters sent with the command and their legal range. The default parameter values are assumed the same as in the command form unless described otherwise. |
| **Query Response** | Describes the format of the query response and the valid range of output. |
| **Description** | Describes in detail what the command does and refers to additional sources. |
| **Examples** | Presents the proper use of each command and its query (when available). |
| **Related Commands** | Lists commands that affect the use of this command or commands that are affected by this command. |



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# IEEE 488.2 COMMON COMMANDS

## *CLS

| | | |
|---|---|---|
| **Purpose** | Clears the Status Register. | |
| **Type** | IEEE488.2 Common Command | |
| **Command Syntax** | *CLS | |
| **Command Parameters** | None | |
| ***RST Value** | *RST performs all the functions of *CLS | |
| **Query Syntax** | None - Command Only | |
| **Query Parameters** | N/A | |
| **Query Response** | N/A | |
| **Description** | This command clears all event registers, clears the OPC flag and clears all queues (except the output queue). | |
| **Examples** | **Command / Query** | **Response *(Description)*** |
| | `*CLS` | |
| **Related Commands** | None | |



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# *ESE

| | |
|---|---|
| **Purpose** | Sets the bits of the Event Status Enable Register. |
| **Type** | IEEE488.2 Common Command |
| **Command Syntax** | *ESE <mask> |
| **Command Parameters** | <mask> = numeric ASCII value in the range of 0 to 255 |
| ***RST Value** | N/A |
| **Query Syntax** | *ESE? |
| **Query Parameters** | None |
| **Query Response** | Numeric ASCII value from 0 to 255 |
| **Description** | The Event Status Enable command is used to set the bits of the Event Status Enable Register. See ANSI/IEEE488.2-1987 section 11.5.1 for a complete description of the ESE register. A value of 1 in a bit position of the ESE register enables generation of the ESB (Event Status Bit) in the Status Byte by the corresponding bit in the ESR. If the ESB is set in the SRE register then an interrupt will be generated. See the ESR? command for details regarding the individual bits.<br><br>The ESE register layout is:<br><br>Bit 0 - Operation Complete<br>Bit 1 - Request Control (not used)<br>Bit 2 - Query Error<br>Bit 3 - Device Dependent Error (not used)<br>Bit 4 - Execution Error<br>Bit 5 - Command Error<br>Bit 6 - User Request (not used)<br>Bit 7 - Power On<br><br>The Event Status Enable query reports the current contents of the Event Status Enable Register. |

**Examples**

| **Command / Query** | **Response *(Description)*** |
|---|---|
| `*ESE 36` | |
| `*ESE?` | 36 |

| | |
|---|---|
| **Related Commands** | *ESR? |



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# *ESR?

| | |
|---|---|
| **Purpose** | Queries and clears the Standard Event Status Register. |
| **Type** | IEEE488.2 Common Command |
| **Command Syntax** | None - Query Only |
| **Command Parameters** | N/A |
| ***RST Value** | N/A |
| **Query Syntax** | ESR? |
| **Query Parameters** | None |
| **Query Response** | Numeric ASCII value from 0 to 255 |
| **Description** | The Event Status Register query - queries and clears the contents of the Standard Event Status Register. This register is used in conjunction with the ESE register to generate the ESB (Event Status Bit) in the Status Byte.<br><br>The layout of the ESR is:<br><br>Bit 0 - Operation Complete<br>Bit 1 - Request Control (not used)<br>Bit 2 - Query Error<br>Bit 3 - Device Dependent Error (not used)<br>Bit 4 - Execution Error<br>Bit 5 - Command Error<br>Bit 6 - User Request (not used)<br>Bit 7 - Power On<br><br>The Operation Complete bit is set by the VM8016 when it receives an *OPC command.<br><br>The Query Error bit is set when data is over-written in the output queue. This could occur if one query is followed by another without reading the data from the first query.<br><br>The Execution Error bit is set when an execution error is detected. Errors that range from -200 to -299 are execution errors.<br><br>The Command Error bit is set when a command error is detected. Errors that range from -100 to -199 are command errors.<br><br>The Power On bit is set when the module is first powered on or after it receives a reset via the VXI Control Register. Once the bit is cleared (by executing the *ESR? command) it will remain cleared. |

| **Examples** | **Command / Query** | **Response *(Description)*** |
|---|---|---|
| | `*ESR?` | 4 |
| **Related Commands** | *ESE | |



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# *IDN?

| | | |
|---|---|---|
| **Purpose** | Queries the module for its identification string. | |
| **Type** | IEEE488.2 Common Command | |
| **Command Syntax** | None - Query Only | |
| **Command Parameters** | N/A | |
| ***RST Value** | N/A | |
| **Query Syntax** | *IDN? | |
| **Query Parameters** | None | |
| **Query Response** | ASCII character string | |
| **Description** | The Identification query returns the identification string of the VM8016 module. The response is divided into four fields separated by commas. The first field is the manufacturer's name, the second field is the model number, the third field is an optional serial number and the fourth field is the firmware revision number. If a serial number is not supplied, the third field is set to 0 (zero). | |
| **Examples** | **Command / Query** | **Response *(Description)*** |
| | `*IDN?` | VXI Technology Inc.,VM8016,0,1.00 |
| **Related Commands** | None | |



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# *OPC

| | | |
|---|---|---|
| **Purpose** | Sets the OPC bit in the Event Status Register. | |
| **Type** | IEEE488.2 Common Command | |
| **Command Syntax** | *OPC | |
| **Command Parameters** | None | |
| ***RST Value** | *RST removes any pending *OPC request | |
| **Query Syntax** | *OPC? | |
| **Query Parameters** | None | |
| **Query Response** | 1 | |
| **Description** | The Operation Complete command sets the OPC bit in the Event Status Register when all pending operations have completed. The Operation Complete query will return a 1 to the output queue when all pending operations have completed, specifically, the operations of connecting or disconnecting channels (ROUTe:CLOSe or ROUTe:OPEN). When a relay changes, the operation isn't complete until the relay settles. | |
| **Examples** | **Command / Query** | **Response *(Description)*** |
| | `*OPC`<br>`*OPC?` | 1 |
| **Related Commands** | *WAI | |



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# *RST

| | | |
|---|---|---|
| **Purpose** | Resets the module's hardware and software to a known state. | |
| **Type** | IEEE488.2 Common Command | |
| **Command Syntax** | *RST | |
| **Command Parameters** | None | |
| ***RST Value** | N/A | |
| **Query Syntax** | None - Command Only | |
| **Query Parameters** | N/A | |
| **Query Response** | N/A | |
| **Description** | The Reset command resets the module's hardware and software to a known state. See the command index at the beginning of this chapter for the default parameter values set by this command. | |
| **Examples** | **Command / Query** | **Response *(Description)*** |
| | `*RST` | |
| **Related Commands** | None | |



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# *SRE

| | | |
|---|---|---|
| **Purpose** | Set the service request enable register. | |
| **Type** | IEEE 488.2 Common Command | |
| **Command Syntax** | *SRE <mask> | |
| **Command Parameters** | <mask> = Numeric ASCII value in the range of 0 to 255 | |
| ***RST Value** | N/A | |
| **Query Syntax** | *SRE? | |
| **Query Parameters** | None | |
| **Query Response** | Numeric ASCII value from 0 to 255 | |
| **Description** | The service request enable mask is used to control which bits in the status byte generate back plane interrupts. If a bit is set in the mask that newly enables a bit set in the status byte and interrupts are enabled, the module will generate a REQUEST TRUE event via an interrupt. See the *STB? Command for the layout of bits. **Note**: Bit 6 is always internally cleared to zero as required by IEEE 488.2 section 11.3.2.3.<br><br>The layout of the Service Request Enable Register is:<br><br>Bit 0 - Unused<br>Bit 1 - Unused<br>Bit 2 - Error Queue Has Data<br>Bit 3 - Questionable Status Summary (not used)<br>Bit 4 - Message Available<br>Bit 5 - Event Status Summary<br>Bit 6 - 0<br>Bit 7 - Operation Status Summary | |
| **Examples** | **Command / Query** | **Response *(Description)*** |
| | `*SRE 4`<br>`*SRE?` | <br>4 |
| **Related Commands** | None | |



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# *STB?

| | | |
|---|---|---|
| **Purpose** | Queries the Status Byte Register. | |
| **Type** | IEEE488.2 Common Command | |
| **Command Syntax** | None - Query Only | |
| **Command Parameters** | N/A | |
| ***RST Value** | N/A | |
| **Query Syntax** | *STB? | |
| **Query Parameters** | None | |
| **Query Response** | Numeric ASCII value from 0 to 255 | |
| **Description** | The Read Status Byte query fetches the current contents of the Status Byte Register. See the IEEE 488.2 specification for additional information regarding the Status Byte Register and its use.<br><br>The layout of the Status Byte Register is:<br><br>Bit 0 - Unused<br>Bit 1 - Unused<br>Bit 2 - Error Queue Has Data<br>Bit 3 - Questionable Status Summary (not used)<br>Bit 4 - Message Available<br>Bit 5 - Event Status Bit (ESB)<br>Bit 6 - Master Summary Status<br>Bit 7 - Operation Status Summary | |
| **Examples** | **Command / Query** | **Response *(Description)*** |
| | `*STB?` | 16 |
| **Related Commands** | None | |



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# *TRG

| | | |
|---|---|---|
| **Purpose** | Causes a trigger event to occur. | |
| **Type** | IEEE488.2 Common Command | |
| **Command Syntax** | *TRG | |
| **Command Parameters** | None | |
| ***RST Value** | N/A | |
| **Query Syntax** | None - Command Only | |
| **Query Parameters** | N/A | |
| **Query Response** | N/A | |
| **Description** | The Trigger command is included for SCPI compliance and has no effect on the VM8016. | |
| **Examples** | **Command / Query** | **Response *(Description)*** |
| | `*TRG` | |
| **Related Commands** | None | |



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# *TST?

| | | |
|---|---|---|
| **Purpose** | Causes a self-test procedure to occur and queries the results. | |
| **Type** | IEEE488.2 Common Command | |
| **Command Syntax** | None - Query Only | |
| **Command Parameters** | N/A | |
| ***RST Value** | N/A | |
| **Query Syntax** | *TST? | |
| **Query Parameters** | None | |
| **Query Response** | Numeric ASCII value from 0 to 255 | |
| **Description** | The Self-Test query causes the VM8016 to run a self-test. | |
| **Examples** | **Command / Query** | **Response *(Description)*** |
| | `*TST?` | 0 *(A return of 0 indicates self-test passed.)* |
| **Related Commands** | None | |



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# *WAI

| | | |
|---|---|---|
| **Purpose** | Halts execution of additional commands and queries until the No Operation Pending message is true. | |
| **Type** | IEEE488.2 Common Command | |
| **Command Syntax** | *WAI | |
| **Command Parameters** | None | |
| ***RST Value** | N/A | |
| **Query Syntax** | None - Command Only | |
| **Query Parameters** | N/A | |
| **Query Response** | N/A | |
| **Description** | The Wait to Continue command halts the execution of additional commands and queries until the No Operation Pending message is true. This command makes sure that all previous commands have been executed before proceeding. It provides a way of synchronizing the module with its commander, specifically, the operations of connecting or disconnecting channels (ROUTe:CLOSe or ROUTe:OPEN). When a relay changes, the operation isn't complete until the relay settles. | |
| **Examples** | **Command / Query** | **Response *(Description)*** |
| | `*WAI` | |
| **Related Commands** | *OPC | |



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# INSTRUMENT SPECIFIC SCPI COMMANDS



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# ROUTe:CLOSe

| | | |
|---|---|---|
| **Purpose** | Connect a channel with its output pins. | |
| **Type** | Setting | |
| **Command Syntax** | [ROUTe:]CLOSe <channel> | |
| **Command Parameters** | <channel> = 1 \| 2 \| 3 \| 4 \| 5 \| 6 \| 7 \| 8 \| 9 \| 10 \| 11 \| 12 \| 13 \| 14 \| 15 \| 16 | |
| ***RST Value** | All channels open | |
| **Query Syntax** | [ROUTe:]CLOSe? <channel> | |
| **Query Parameters** | <channel> = 1 \| 2 \| 3 \| 4 \| 5 \| 6 \| 7 \| 8 \| 9 \| 10 \| 11 \| 12 \| 13 \| 14 \| 15 \| 16 | |
| **Query Response** | 0 \| 1 (0 = False (open), 1 = True (closed)) | |
| **Description** | The Route Close command connects the indicated channel to the front panel Common connector. Channels 1 through 8 will be routed to Common0, and Channels 9 through 16 will be routed to Common1. | |
| **Examples** | **Command / Query** | **Response *(Description)*** |
| | `CLOS 2`<br>`CLOS? 2` | *(Connects channel two to its front panel connector.)*<br>*(Ask if Channel 2 is connected to the front panel Common connector. The response says it is connected.)* |
| **Related Commands** | ROUTe:DELay<br>ROUTe:OPEN | |



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# ROUTe:DELay

| | | |
|---|---|---|
| **Purpose** | Sets the relay settling time. | |
| **Type** | Setting | |
| **Command Syntax** | [ROUTe:]DELay <delay time> | |
| **Command Parameters** | <delay time> = 0 to 1374 seconds at 0.000001 steps | |
| ***RST Value** | 0.002 seconds | |
| **Query Syntax** | [ROUTe:]DELay? | |
| **Query Parameters** | None | |
| **Query Response** | 0 to 1374 at 0.000001 steps | |
| **Description** | The Route Delay command sets the relay settling time. The default setting of 0.002 is usually used. | |
| **Examples** | **Command / Query** | **Response *(Description)*** |
| | `DEL 0.005`<br>`DEL?` | *(Sets the delay to 0.005 seconds.)*<br>0.005 (*Ask for the delay setting. The response says the delay is set to 0.005 seconds.)* |
| **Related Commands** | ROUTe:CLOSe<br>ROUTe:OPEN | |



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# ROUTe:OPEN

| | |
|---|---|
| **Purpose** | Disconnect a channel from its output pins. |
| **Type** | Setting |
| **Command Syntax** | [ROUTe:]OPEN <channel> |
| **Command Parameters** | <channel> = 1 \| 2 \| 3 \| 4 \| 5 \| 6 \| 7 \| 8 \| 9 \| 10 \| 11 \| 12 \| 13 \| 14 \| 15 \| 16 |
| ***RST Value** | All channels open |
| **Query Syntax** | [ROUTe:]OPEN? <channel> |
| **Query Parameters** | <channel> = 1 \| 2 \| 3 \| 4 \| 5 \| 6 \| 7 \| 8 \| 9 \| 10 \| 11 \| 12 \| 13 \| 14 \| 15 \| 16 |
| **Query Response** | 0 \| 1 (0 = False (closed), 1 = True (open)) |
| **Description** | The Route Open command disconnects the indicated channel from the front panel connector Common.<br><br>If this command is used without the channel parameter, then all channels will be opened. If a query is made without the channel parameter, a 1 (or true) returned signifies that all channels are open, while a 0 (or false) returned means that at least one channel is closed. |

| **Examples** | **Command / Query** | **Response *(Description)*** |
|---|---|---|
| | `OPEN 2` | *(Disconnects Channel 2 from the front panel connector Common.)* |
| | `OPEN? 2` | *(Ask if Channel 2 is disconnected from the front panel connector Common. The response says it is disconnected.)* |
| | `OPEN` | *(Disconnects all channels from the front panel connector Common.)* |
| | `OPEN?` | 1 *(Verifies that all channels are disconnected from the front panel connector Common.)* |

| | |
|---|---|
| **Related Commands** | ROUTe:CLOSe<br>ROUTe:DELay |



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# ROUTe:SPECial

| | |
|---|---|
| **Purpose** | Allows for single or multiple channel operation. |
| **Type** | Setting |
| **Command Syntax** | [ROUTe:]SPECial <boolean> |
| **Command Parameters** | <boolean> = 0 \| 1 \| OFF \| ON |
| ***RST Value** | 0 |
| **Query Syntax** | [ROUTe:]SPECial? |
| **Query Parameters** | None |
| **Query Response** | 0 \| 1 |
| **Description** | The Route Special command allows more than one channel to be routed to the Common pins on the front panel connector. When Special is off, only one channel can be routed to each Common connection. Channels 1 through 8 can be routed to Common0, and Channels 9 through 16 can be routed to Common1. When Special is on, Channels 1 through 8 can be routed to Common0 simultaneously. Likewise, and Channels 9 through 16 can be routed to Common1 simultaneously.<br><br>Route Special must be disabled to get make-before-break functionality. |

| **Examples** | **Command / Query** | **Response *(Description)*** |
|---|---|---|
| | `SPEC ON`<br>`SPEC?` | <br>1 |

| | |
|---|---|
| **Related Commands** | ROUTe:CLOSe<br>ROUTe:DELay<br>ROUTe:OPEN |



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# ROUTe:TYPE

| | |
|---|---|
| **Purpose** | Select 2-wire or 4-wire operation. |
| **Type** | Setting |
| **Command Syntax** | [ROUTe:]TYPE <type> |
| **Command Parameters** | <type> = 2 \| 4 |
| ***RST Value** | 2 |
| **Query Syntax** | [ROUTe:]TYPE? |
| **Query Parameters** | N/A |
| **Query Response** | 2 \| 4 |
| **Description** | The Route Type command sets the device for 2-wire or 4-wire operation. For 2-wire operation, the 16 channels operate independently. For 4-wire operation, Channels 1 through 8 are paired with Channels 9 through 16. The default setting is for 2-wire operation. |

| **Examples** | **Command / Query** | **Response *(Description)*** |
|---|---|---|
| | `TYPE 4`<br>`TYPE?` | <br>4 |

| | |
|---|---|
| **Related Commands** | ROUTe:CLOSe<br>ROUTe:OPEN |



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# REQUIRED SCPI COMMANDS

## STATus:OPERation:CONDition?

| | | |
|---|---|---|
| **Purpose** | Queries the Operation Status Condition Register. | |
| **Type** | Required SCPI command | |
| **Command Syntax** | None - Query Only | |
| **Command Parameters** | N/A | |
| ***RST Value** | N/A | |
| **Query Syntax** | STATus:OPERation:CONDition? | |
| **Query Parameters** | None | |
| **Query Response** | 0 | |
| **Description** | The Operation Status Condition Register query is provided for SCPI compliance only. The VM8016 does not alter the state of any of the bits in this register and always reports a 0. | |
| **Examples** | **Command / Query** | **Response *(Description)*** |
| | `STAT:OPER:COND?` | 0 |
| **Related Commands** | None | |



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# STATus:OPERation:ENABle

| | |
|---|---|
| **Purpose** | Sets the Operation Status Enable Register. |
| **Type** | Required SCPI command |
| **Command Syntax** | STATus:OPERation:ENABle <NRF> |
| **Command Parameters** | <NRF> = numeric ASCII value from 0 to 32767 |
| ***RST Value** | N/A |
| **Query Syntax** | STATus:OPERation:ENABle? |
| **Query Parameters** | None |
| **Query Response** | Numeric ASCII value from 0 to 32767 |
| **Description** | The Operation Status Enable Register is included for SCPI.<br><br>The register layout is as follows:<br><br>Bit 0 - Calibrating (not used on the VM8016)<br>Bit 1 - Setting (not used on the VM8016)<br>Bit 2 - Ranging (not used on the VM8016)<br>Bit 3 - Sweeping (not used on the VM8016)<br>Bit 4 - Measuring (not used on the VM8016)<br>Bit 5 - Waiting for trigger (not used on the VM8016)<br>Bit 6 - Waiting for arm (not used on the VM8016)<br>Bit 7 - Correcting (not used on the VM8016) |

| **Examples** | **Command / Query** | **Response *(Description)*** |
|---|---|---|
| | `STAT:OPER:ENAB 0`<br>`STAT:OPER:ENAB?` | <br>0 |

| | |
|---|---|
| **Related Commands** | None |



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# STATus:OPERation:EVENt?

| | |
|---|---|
| **Purpose** | Queries the Operation Status Event Register. |
| **Type** | Required SCPI command |
| **Command Syntax** | None - Query Only |
| **Command Parameters** | N/A |
| ***RST Value** | N/A |
| **Query Syntax** | STATus:OPERation [:EVENt] ? |
| **Query Parameters** | None |
| **Query Response** | 0 |
| **Description** | The Status Operation Event Register query is included for SCPI compliance.<br><br>The register layout is as follows:<br><br>Bit 0 - Calibrating (not used on the VM8016)<br>Bit 1 - Settling (not used on the VM8016)<br>Bit 2 - Ranging (not used on the VM8016)<br>Bit 3 - Sweeping (not used on the VM8016)<br>Bit 4 - Measuring (not used on the VM8016)<br>Bit 5 - Waiting for trigger (not used on the VM8016)<br>Bit 6 - Waiting for arm (not used on the VM8016)<br>Bit 7 - Correcting (not used on the VM8016) |
| **Examples** | **Command / Query**: `STAT:OPER?` — **Response *(Description)***: 0 |
| **Related Commands** | None |



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# STATus:PRESet

| | | |
|---|---|---|
| **Purpose** | Presets the Status Registers. | |
| **Type** | Required SCPI command | |
| **Command Syntax** | STATus:PRESet | |
| **Command Parameters** | None | |
| ***RST Value** | N/A | |
| **Query Syntax** | None - Command Only | |
| **Query Parameters** | N/A | |
| **Query Response** | N/A | |
| **Description** | The Status Preset command presets the Status Registers. The Operational Status Enable Register is set to 0 and the Questionable Status Enable Register is set to 0. This command is provided for SCPI compliance only. | |
| **Examples** | **Command / Query** | **Response *(Description)*** |
| | `STAT:PRES` | |
| **Related Commands** | None | |



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# STATus:QUEStionable:CONDition?

| | | |
|---|---|---|
| **Purpose** | Queries the Questionable Status Condition Register. | |
| **Type** | Required SCPI command | |
| **Command Syntax** | None - Query Only | |
| **Command Parameters** | N/A | |
| ***RST Value** | N/A | |
| **Query Syntax** | STATus:QUEStionable:CONDition? | |
| **Query Parameters** | None | |
| **Query Response** | 0 | |
| **Description** | The Questionable Status Condition Register query is provided for SCPI compliance only. The VM8016 does not alter any of the bits in this register and a query always reports a 0. | |
| **Examples** | **Command / Query** | **Response *(Description)*** |
| | `STAT:QUES:COND?` | 0 |
| **Related Commands** | None | |



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# STATus:QUEStionable:ENABle

| | | |
|---|---|---|
| **Purpose** | Sets the Questionable Status Enable Register. | |
| **Type** | Required SCPI command | |
| **Command Syntax** | STATus:QUEStionable:ENABle <NRF> | |
| **Command Parameters** | NRF = numeric ASCII value from 0 to 32767 | |
| ***RST Value** | N/A | |
| **Query Syntax** | STATus:QUEStionable:ENABle? | |
| **Query Parameters** | None | |
| **Query Response** | Numeric ASCII value from 0 to 32767 | |
| **Description** | The Status Questionable Enable command sets the bits in the Questionable Status Enable Register. This command is provided only to comply with the SCPI standard.<br><br>The Status Questionable Enable query reports the contents of the Questionable Status Enable Register. The VM8016 does not alter the bit settings of this register and will report the last programmed value. | |
| **Examples** | **Command / Query** | **Response *(Description)*** |
| | `STAT:QUES:ENAB 64`<br>`STAT:QUES:ENAB?` | 64 |
| **Related Commands** | None | |



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# STATus:QUEStionable:EVENt

| | | |
|---|---|---|
| **Purpose** | Queries the Questionable Status Event Register. | |
| **Type** | Required SCPI command | |
| **Command Syntax** | None - Query Only | |
| **Command Parameters** | N/A | |
| ***RST Value** | N/A | |
| **Query Syntax** | STATus:QUEStionable[:EVENt]? | |
| **Query Parameters** | None | |
| **Query Response** | 0 | |
| **Description** | The Questionable Status Event Register is provided for SCPI compliance only. The VM8016 does not alter the bits in this register and queries always report a 0 | |
| **Examples** | **Command / Query** | **Response *(Description)*** |
| | `STAT:QUES?` | 0 |
| **Related Commands** | None | |



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# SYSTem:ERRor?

| | | |
|---|---|---|
| **Purpose** | Queries the Error Queue | |
| **Type** | Required SCPI command | |
| **Command Syntax** | None - Query Only | |
| **Command Parameters** | N/A | |
| ***RST Value** | N/A | |
| **Query Syntax** | SYSTem:ERRor? | |
| **Query Parameters** | None | |
| **Query Response** | ASCII string | |
| **Description** | The System Error query is used to retrieve error messages from the error queue. The error queue will maintain up to ten error messages. If additional errors occur, the queue will overflow and the tenth and subsequent error messages will be lost. In the case of an overflow, an overflow message will replace the tenth error message. See the SCPI standard Volume 2: Command Reference for details on errors and reporting them. | |
| **Examples** | **Command / Query** | **Response *(Description)*** |
| | `SYST:ERR?` | -350 *(No error.)* |
| **Related Commands** | None | |



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# SYSTem:VERSion?

| | | |
|---|---|---|
| **Purpose** | Queries the SCPI version number to which the VM8016 complies. | |
| **Type** | Required SCPI command | |
| **Command Syntax** | None - Query Only | |
| **Command Parameters** | N/A | |
| ***RST Value** | N/A | |
| **Query Syntax** | SYSTem:VERSion? | |
| **Query Parameters** | None | |
| **Query Response** | Numeric ASCII value | |
| **Description** | The System Version query reports version of the SCPI standard with which the VM8016 complies. | |
| **Examples** | **Command / Query** | **Response *(Description)*** |
| | `SYST:VERS?` | 1994.0 |
| **Related Commands** | None | |



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# INDEX


***Symbol***

*CLS ..... 32
*ESE ..... 33
*ESR? ..... 34
*IDN? ..... 35
*OPC ..... 36
*OPC? ..... 36
*RST ..... 37
*SRE ..... 38
*STB? ..... 39
*TRG ..... 40
*TST? ..... 41
*WAI ..... 42

***2***

2-wire ..... 14, 48

***4***

4-wire ..... 14, 48

***B***

backplane ..... 21
banks ..... 14

***C***

cable ..... 10
clear ..... 32
common ..... 46
common connection ..... 47
common connector ..... 44
connector ..... 19
cooling ..... 17

***D***

default parameter ..... 37
direct register access ..... 13
dynamic address configuration ..... 18

***E***

electric shock ..... 10
error messages ..... 56
errors ..... 34
explosive atmosphere ..... 10

***G***

grounding conductor ..... 10

***K***

keyword ..... 22, 23

***L***

logical address ..... 17, 18

***M***

message-based ..... 13, 14, 21

***N***

normal mode ..... 14

***O***

overheating ..... 10

***P***

parameter ..... 22, 23
parameters ..... 27
pin locations ..... 19
power ..... 17, 18
power cord ..... 10
probes ..... 10
programming language ..... 21

***R***

register ..... 33, 34, 36, 38, 39, 49, 50, 51, 52, 53, 54, 55
register access ..... 24
relay settling time ..... 45
ROUTe:CLOSe ..... 44
ROUTe:DELay ..... 45
ROUTe:OPEN ..... 46
ROUTe:SPECial ..... 47
ROUTe:TYPE ..... 48

***S***

SCPI compatible ..... 14
SCPI standard ..... 13, 57
Special mode ..... 14
STATus:OPERation:CONDition? ..... 49
STATus:OPERation:ENABle ..... 50
STATus:OPERation:EVENt? ..... 51
STATus:PRESet ..... 52
STATus:QUEStionable:CONDition? ..... 53
STATus:QUEStionable:ENABle ..... 54
STATus:QUEStionable:EVENt ..... 55
synchronizing ..... 42
syntax ..... 21
SYSTem:ERRor? ..... 56
SYSTem:VERSion? ..... 57

***T***

temperature range ..... 10
test leads ..... 10
tree-structured language ..... 21

***V***

ventilation ..... 10
VMIP ..... 13, 14, 18
VXI Modular Instrumentation Platform ..... 13
VXIbus ..... 13, 14, 17, 18, 21

***W***

WEEE ..... 9
wet or damp conditions ..... 10
word-serial ..... 13, 14




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